FLUORIDATION OF WATER AND THE PREVENTION OF DENTAL DECAY.

Ministry of Health
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Dental decay, technically known as caries, is one of the commonest of all diseases and occurs in the great majority of the people in this country. Even young children are affected, and it has been found that at least half of the children entering school at 5 years of age already have 5 or 6 defective teeth. The suffering which decayed and septic teeth cause is only too well known. What is perhaps not so fully appreciated is that the poisoning of the body caused by dental disease can have far-reaching effects on general health and is a contributory factor in other more serious diseases.

It is most important, therefore, that dental caries should be reduced, and the most effective means of achieving this which has so far been discovered is the fluoridation of water supplies in those areas where the fluoride content is low.* The other known methods of preventing caries, such as dental hygiene, health education, advice on diet and regular dental treatment, must, of course, continue simultaneously and, if possible, be intensified.

Fluoride (as fluoride ions) is present in small amounts naturally in most water supplies. In different parts of the world the concentration varies from a trace to 14 parts per million or more. The highest natural concentration in Great Britain is about 6 parts per million.

Effect on the Teeth

It has been known for more than 20 years that when fluoride is present in the drinking water there is a reduced liability to dental decay. Extensive investigations in the United States and in this country have shown that children born and brought up in an area with about 1 part per million of fluoride in the water have 50-60% less dental decay than those brought up in areas where the water is deficient in fluoride, and, in addition, where there is sufficient fluoride in the water 30% of the school children have completely sound teeth. There is strong evidence, too, that the benefit persists well into middle age.

The beneficial action of low levels of fluoride was not at first known, for the object of early research work was to find the cause of the peculiar mottling of teeth which had been noted in certain areas. It was found that with an exceptionally high concentration of 5 parts per million, or more, of fluoride some of the teeth showed brown staining and even pitting of the enamel, while others had a chalk-white appearance which gave rise to the

*Fluoridation of a water supply means the addition of soluble fluoride in accurately controlled amounts. It is dissolved in water and a solution of predetermined strength of the salt is prepared using precise measuring equipment. This solution is added to the main water supply in such a way that complete mixing takes place. The final concentration of the fluoride salt in the water supply is so small, of the order of only 1 part per million (F), that complete ionisation takes place yielding fluoride ions; it is these ions that are the active agents in the protection of teeth against dental decay.

term " mottled enamel " or " dental fluorosis ". It is unfortunate that this same term is often used to describe the small white opacities hardly noticeable to the ordinary eye which can occur on a few teeth even with low levels of fluoride, thereby wrongly implying a defect. On the contrary, with low levels of fluoride the structure of the teeth is improved and their shining white quality is attractive. Defects in the enamel which frequently occur in areas with no fluoride in the water, and are probably due to faulty calcification, are much more noticeable.

Fluoridation

It was found in the United States, and amply confirmed in this country, that at a level of about 1 part per million of fluoride, dental decay is reduced by about 60% without causing any serious mottling of the teeth. This led a number of communities in the United States which had little or no fluoride in their water supplies and a high incidence of dental decay to consider adding fluoride to make up the deficiency. In a temperate zone, the level usually aimed at is 1.0 to 1.2 parts per million.

In most of the American studies of fluoridation the community which has adopted fluoridation has been paired with a similar community whose water supply contains negligible amounts of fluoride. The children's teeth have been examined each year and the findings for the two areas have been compared. A comparison has also been made with the findings before fluoridation was introduced and in some instances with those in an area where the water contains natural fluoride at a similar level. These observations on teeth and on general health have now been in progress on the other side of the Atlantic for up to 10 years. The results have entirely fulfilled expectations ; the effect of fluoride added to the water has been found to be indistinguishable from that of the naturally occurring substances. *No ill-effect on health has been detectable at any age.* Some 24 million people in the U.S.A. are now consuming naturally or artificially fluoridated water.

In 1952, on the recommendation of the Medical Research Council, the Government sent a mission to the U.S.A. and Canada to study fluoridation in operation and to advise on the desirability of instituting fluoridation in this country. The following is an extract from the Mission's Report: " We consider fluoridation to be a useful means of reducing the incidence of dental caries in North America. It is reasonable to assume that it would also be useful in this country. . . . It would be advisable in the first instance to add flouride to the water supplies of some selected communities. These preliminary fluoridation projects should be regarded as study centres. . . . "

Plans for Fluoridation in this Country

The Mission's recommendations were accepted by the Government. A number of Local Authorities had already passed resolutions expressing the wish to introduce fluoridation of their water supplies. These were considered in Government Departments and a number of areas have been selected for the preliminary studies recommended by the Mission, while comparable areas have been selected as controls. The areas were chosen to ensure the representation of various parts of the country and different types of community. These areas are to be the subject of controlled demonstrations, not experiments, for the results to be expected are already fully attested by American experience. The purpose of these demonstrations is not to verify that fluoridation is safe, for that has already been established, but to measure the extent of the benefit derived in this country so as to be able later on to judge whether the process should be applied more widely.

Fluoride is found to be most beneficial if it is consumed while the teeth are developing and calcifying, that is during the first 8 years of life. The full effect of fluoridation, therefore, can be expected to show first on the teeth of young children. In order that this may be properly measured, dental examinations will be carried out on children and will be repeated at regular intervals over a period of years so as to give an adequate picture of results. Approximately 150 children in each age group 3-14 years will be examined in each area, and the examinations will be carried out by a group of dentists who will follow agreed standards for the assessment of caries and agreed methods of examination.

In all study areas the water supply has been carefully surveyed and arrangements are being made to ensure that the desired concentration of 1 part per million is accurately added and checked. The expert staffs of the Government Chemist's Department, the Ministries of Health and of Housing and Local Government, the Department of Health for Scotland and the Welsh Board of Health, are actively participating and the Health Departments are to bear the cost. Fluoride can be added to a water supply with great accuracy and the equipment used is similar to that already in use in this country for the treatment of water, and with the knowledge of ten years' experience in the United States there is no reason to expect any serious difficulties in either the mechanism or the control of fluoridation in this country.

Comparability with the United States

It has been alleged by some people that American experience is not directly applicable here and that our dietary habits may lead to a difference in fluoride intake and so invalidate comparison. There is, however, every reason to think that in nearly every respect the fluoride content of the diet here and in the United States is closely similar. The only articles of diet in which there might be differences of consumption are tea, fish and to a less extent beer, all substances with a relatively high fluoride content, because they may be taken in greater quantities here than in the U.S.A. However, studies of the diets of children and also the close correspondence of British and American studies of mottling and dental caries in children show that these substances are not extensively taken by children and that in fact the fluoride intake of children in the two countries is very similar indeed. Confirmatory studies have been undertaken in the examination of urine for fluoride and these led to the same conclusion. In adults, the margin of safety is very high indeed even allowing for the possibility of a greater intake of tea, fish and beer.

Duration of Dental Benefit

It has been said by some people that only children will benefit from fluoridation and that to cause everybody in the community to drink fluoridated water is both wasteful and unjustified. This is not the case. It is true that in order to obtain maximum benefit the water containing fluoride should be consumed during the time when the teeth are calcifying, i.e., during the first eight years of life. Teeth which have received fluoride in this way retain their relative immunity to decay well on into middle life at least, and to some extent the effect appears to last throughout life. However, those who come into areas where the water is fluoridated after five years of age do also receive some benefit. There is evidence that older children too have their dental condition substantially improved by consuming fluoridated water, and eventually all ages will benefit.

A number of attempts have been made to find alternative methods of administering fluoride. The local application of fluoride solutions to the surface of the teeth has been tried as also has the administration of sodium fluoride in tablet form. Neither of these methods, however, has proved anything like as practicable as putting the right amount of fluoride in the water supply; both the alternatives could be hazardous and need careful professional control and neither is so safe nor so likely to be consistently applied.

Medical Aspects

It has been suggested that the long-continued consumption of fluoride may lead to harmful effects on the health, especially of adults. The consumption of water containing exceedingly high concentrations of fluoride and the inhalation of and absorption of high concentrations of fluoride during certain industrial processes do lead to ill effects on the skeleton and especially on the spine. *There is, however, no scientific evidence whatever that fluoride at a level of 1 part per million has any deleterious effect on the health of adults or children.* For example, in a community whose water supply contained as much as 8 parts per million of fluoride, careful examination was made of a group who had consumed this water for a minimum of 25 years, and showed that, apart from mottling of the teeth, no important effect could be found in these people to differentiate them from those in a similar community with a low fluoride content in its water; in particular there was no radiological evidence of changes found in the spine. The addition of 1 part per million of fluoride to a water supply in this country could not possibly bring the dietary intake anywhere near the amount consumed by this American community. Moreover, under temperate conditions at least 95% of fluoride ingested at a level of 1 part per million is promptly excreted in the urine, faeces and sweat. Some at any rate of the remainder is deposited normally throughout life in the bone, for everybody's bones contain a certain amount of fluoride, but except under conditions of severe industrial or natural fluorosis this deposit is evidently a normal process. It may even be necessary for healthy bone formation, though there is at present no definite proof of this. It is, however, known how high a concentration of fluoride in bone must be reached before abnormal changes take place, and it can be demonstrated that under the dietary conditions existing in this country, with a fluoride content in drinking water of 1 part per million the intake of a life-time would still leave the content of fluoride in the bone far below this.

No Adverse Effects on Water

If it is argued that the addition of fluoride to water affects the "purity" of the water, it can be answered that water in nature is never chemically pure and that most waters have to be treated chemically before they are suitable for public supply, about thirty chemicals being used in water works to produce clear and wholesome water suitable for domestic and industrial purposes.

The addition of 1 part per million of fluoride to a water supply does not affect its taste, its steam-raising properties, its effect on cooking or cooking utensils, or on plumbing, nor its hardness or softness. In fact it simply increases the concentration of ions naturally present and there is no evidence that fluoridated water has any adverse effect on any domestic use or industrial process.

The Liberty of the Subject

The addition of fluoride to a water supply is, of course, easily made a subject of controversy, as it raises the age-old conflict between the rights of

the private conscience and the needs of the public good. It has been suggested by some people that the addition of fluoride to the water supply is "mass medication", forcing the community to take a "foreign" substance whether they wish to or not. But fluoride as added to water supplies is not a foreign substance. It is already present in varying quantity in most water supplies all over the country and the properties of water to which this substance—a natural mineral salt—has been added, are no different in action from those of water in which fluoride is naturally present. The fluoride ion, which is the effective form of fluoride, is the same whatever the exact salt used for fluoridation. Moreover, this is not medication; it does not set out to cure dental caries or any other disease; it is a preventive measure. In one sense, fluoridation may be compared with chlorination. Chlorine is added to water supplies to prevent the growth of harmful organisms; fluoride is to be added to prevent the decay of children's teeth and to prevent consequent ill health then and in later life. The fluoridation of water is comparable with various other measures which have been taken in relation to water and food—for example, the chlorination and other chemical treatment of water, the fortification of margarine with vitamins and the addition of iron to all flour of which the natural content is on average less than 1.6 milligrammes per 100 grammes. In such cases individuals have agreed to concede a little of their freedom in the interest of the community. Without the acceptance of such measures as a social obligation the great progress which has been made in public health and public hygiene could never have been possible.

In other words, the addition of fluoride in a concentration of 1 part per million to a water supply is a public health measure of preventive dentistry. The substance added is indistinguishable from the naturally-occurring fluoride ion and is indeed prepared from the same minerals. It reduces the incidence of dental decay in children by about 60% and it is anticipated that it will do so to a substantial extent in adults also. There is no scientific evidence that in this concentration fluoride has any detectable toxic effect on adults or children, but there is ample evidence from extensive observation that it has an excellent effect on teeth. While research and study of the physiology of this most interesting element will continue, *there is already enough evidence of both the value and harmlessness of fluoridation to justify its controlled use in this country.*

It could well be argued that any delay in taking general and immediate steps to obtain these benefits for all the children of this country is not justified and, indeed, that the Government have no right to withhold these benefits any longer while studies are carried out in a few places to demonstrate the method to be used. If dental disease were as dramatic in its effects as, for example, cholera, the public would certainly make demands of this kind and in face of the enormous amount of work which has already been done and which has proved the value and the safety of fluoridation, if such demands were to be made it would be exceedingly difficult to refuse them. The Government wishes, however, to carry out the controlled demonstrations so that the beneficial effects under British conditions may be exactly assessed and the detailed application of American experience to our circumstances can be accurately worked out.

Summary

To summarise: the Government has every reason to believe that fluoridation is of great benefit in the preservation of the teeth of children, and ultimately also of adults, against dental decay and that it reduces dental decay in children by about 60%. There is no evidence that the consumption of water fluoridated to a level of about 1 part per million has any harmful effects

on those who drink it. We are fortunate in having available not only the experience of some ten years of fluoridation in America, but also that of the life-long consumption of waters containing fluoride naturally, both in America and in this country. While, therefore, all water supplies deficient in fluoride might justifiably be fluoridated at once, it is felt that, before this step is taken, there should be demonstrations in this country, not because it is thought there might be any harmful effects—there is already ample evidence that there are none—but to show the extent of the benefit that fluoridation can bring to this country and how best it can be applied to our circumstances. **This should not be described as "mass medication". What is proposed is to make good a deficiency in those water supplies which lack this beneficial element and to proceed in a carefully-planned and scientific way so as to secure the best possible results in our country.**

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Savile Row,
*London, W.*1. *July,* 1955.

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